Initial development in Embryo/Fetus

(starts with Hyaline Cartilage model of bone)

First Change

Mesenchymal Cells--->Osteoblasts

Osteoid is laid down

Mineralization

Periosteal Collar formed around entire midshaft of cartilage model

Outside of cartilage

Formed by Intramembranous Ossification within periosteum

Second Change

Same time

Perichondrium Becomes Active

Hypertrophy of Chondrocytes

Secrete alkaline phosphatase

Cartilage matrix calcifies

Cartilage cells die bc flow of nutrients is cut off by hydroxyapetite crystals

Midshaft

Periosteal buds

Enter cartilage matrix via holes in forming bone collar

Small Blood Vessels

Erode away uncalcified cartilage matrix

Bring in osteoprogenitor cells

Fifth Change

Bone Trabeculae are formed

Center of calcified cartilage matrix surrounded by bone tissue

Spongy bone with trabecula (first area) = Primary spongiosa

Woven (immature) bone laid down

Random organization of collagen

If compaction occurs (spongy-->dense) osteons = primary osteons

Fourth Change

Calcification of bone osteoid

Appositional bone growth

On free surface of cavity (even though it is inside cartilage model)

Third Change

Osteoprogenitor Cells

Migrate from blood vessel to surface of calcified cartilage matrix

Differentiate into osteoblasts

Lay down osteoid (layer by layer) on suface of remaining calcified cartilage matrix

Same Cartilage model

Different place vs. primary ossification site

Irregular bones have many secondary ossification centers

Secondary Ossification Center

Babies

Formation of ossification centers used to determine bone age of small babies

Epiphysis of long bones

After primary ossification has started

Carpals and Tarsals ossify at specific ages, not depending on size